RSM New Orleans District

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US Army Corps of Engineers
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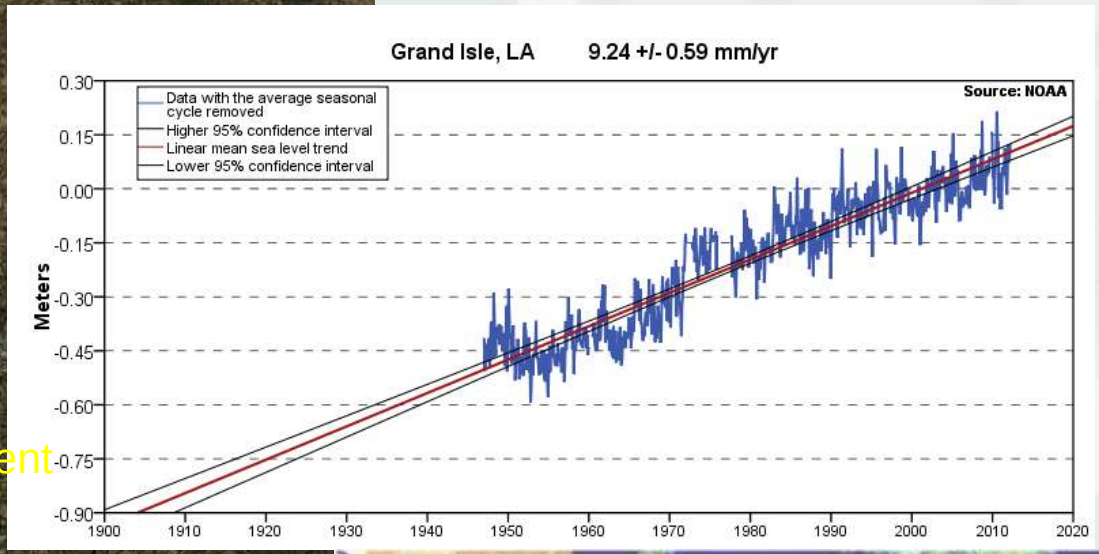
RSM FY12 IPR
New Orleans District

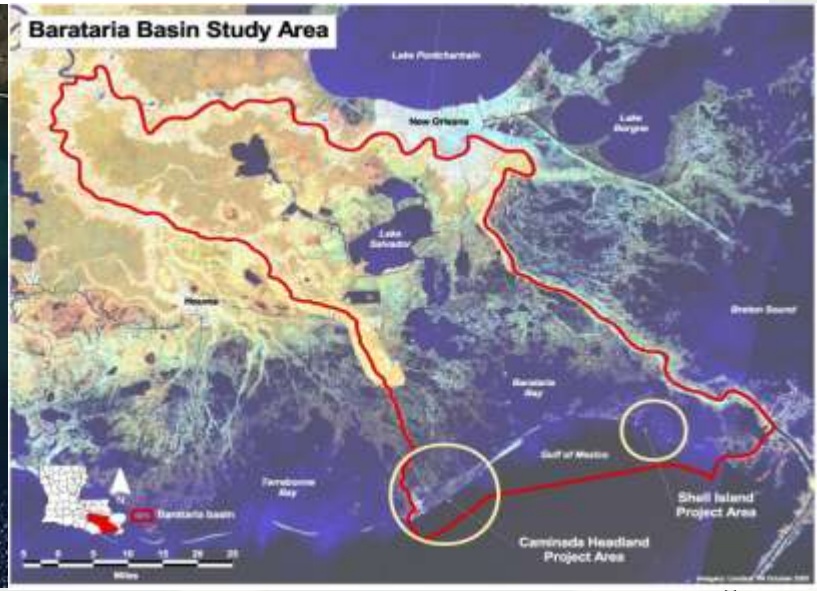
Description/Challenge

- Louisiana Coast Vital to Nation
  - 25% Continental US Fisheries
  - 28% US Entergy (oil, gas)
  - 41% US Oil Refining Capability
- Rapid Wetland Loss and SLR
- Critical Need for sediments Coastal Restoration
- Highly complex ecosystem and sediment dynamics



Goals/Issues to Address

- Quantify understanding of sediment transport and pathways through the coastal zone
- Primary forces affecting sediment input, transport, and movement – winds, waves, deltaic cycles, etc.
- Validate and update Conceptual Budget
- Benefits to Coastal Restoration Projects
  - MRHDMS, LCA, CPRA, River Diversions



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District PDT Members

Cherie Price, Planning, Coastal
Jay Ratcliff, ERDC Coastal & Hydraulics
Del Britsch, Engineering, Geotechnical
Steve Ayres, Engineering, H&H
Andre Dehaan, Engineering, Geospatial

Stakeholders and Partners

Louisiana Coastal Protection Restoration Authority
University of New Orleans
USGS
ERDC-CHL

Leveraging/Collaborative Opportunities

Stakeholders / Partners - Data sets – bathymetry, vibra cores, borings, sediments, water levels, etc.

Projects – LCA, MRHDMS, Louisiana Barrier Island Comprehensive Modeling Program

Milestones/Deliverables

Conceptual Sediment Budget – 100%complete
Acquire Site morphology - 100%complete
Acquire Topo/Bathy - 100%complete
Acquire Sediment Data sets - 80%complete
Coastal Change Data Acquire – 100%complete
Numerical Modeling – 70%complete
FY12 RSM Final Report – 50%complete

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Approach

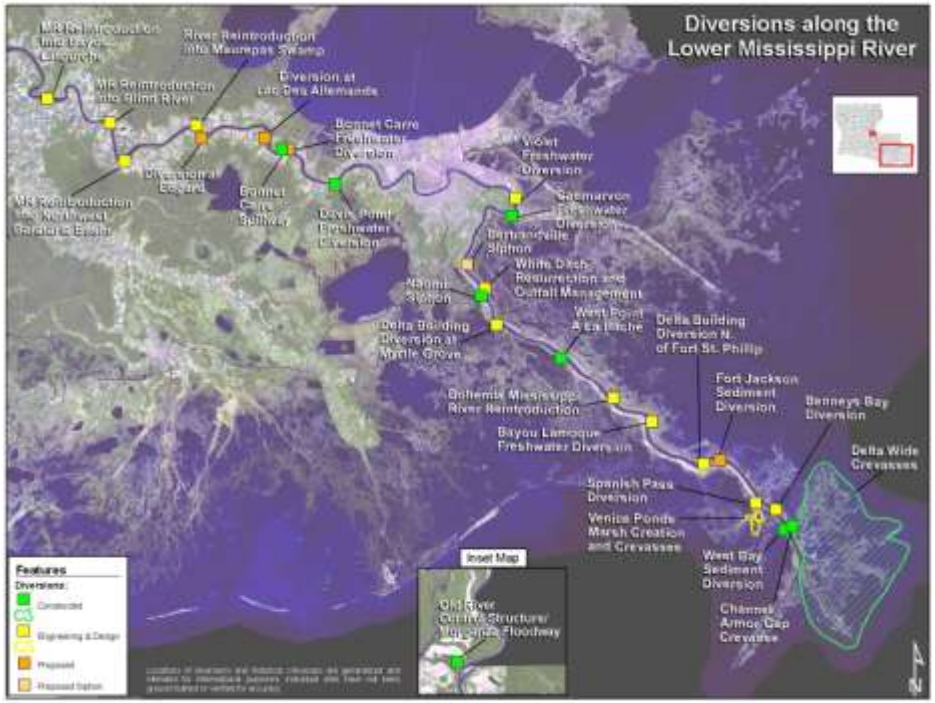
- Create Conceptual Sediment Budget
- Define spatial focus area
- Acquire needed data sets
- Create Numerical (CMS) Model
- Apply Model Results

Models, Tools, Databases, etc Used

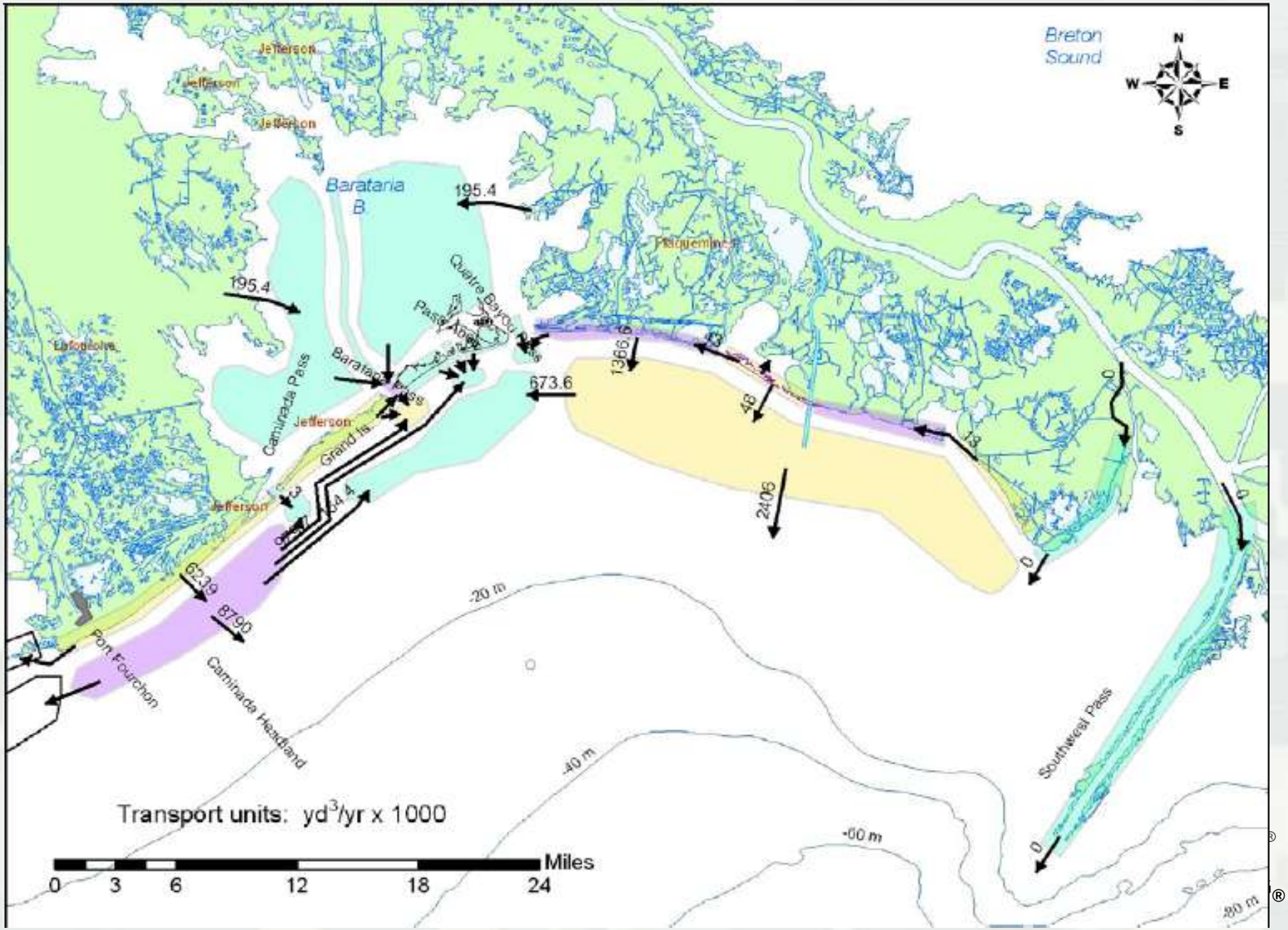
- 1830 – 2007/8 Coastal Change database
- Conceptual SBAS Model
- USACE, State of Louisiana, USGS coastal and sediment databases
- CMS Numerical Model

Benefits to O&M, FRM, Environmental

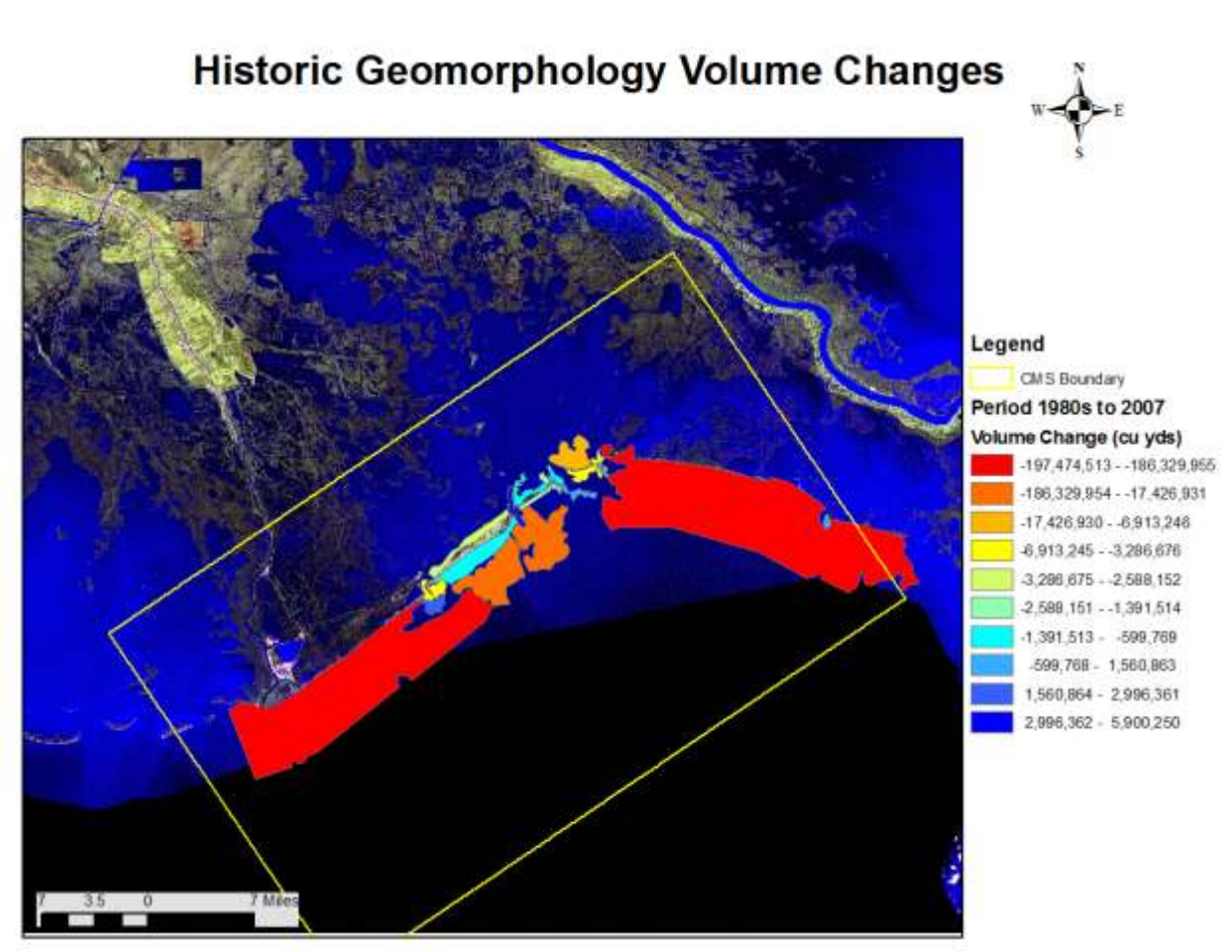
- Quantify sediment and validate pathways
- Identify primary force components
- Establish transport pathways which can be used in alternative analyses –
  - Reduce costs
  - Implement efficient engineering
- Provide critical data to river diversion and ecosystem restoration USACE and CRPA efforts



Conceptual Sediment Budget

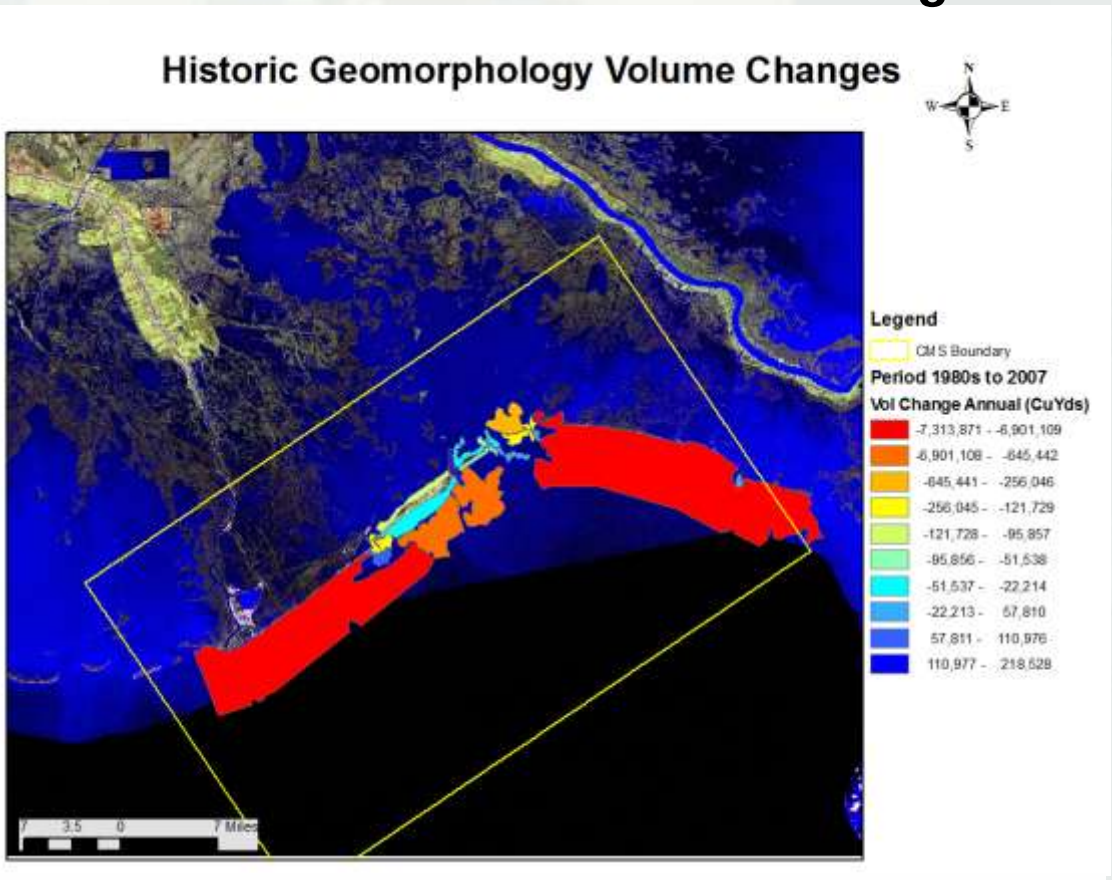


Historic Volume Changes
1980s to 2007



- Back Barrier Erosion
  - 7.7×10^6 cu m
  - >50% fines
- Shore face Erosion
  - $>300 \times 10^6$ cu m
  - 86% fines
- Tidal Inlets Erosion
  - 1.27×10^6 cu m

Annual Historic Volume Changes



Geomorphic unit	Sand Volume change (1980 - 2007) 10^6 m^3 and 10^6 m^3 yr^{-1}	Fine Volume change (1980 - 2007) 10^6 m^3 and 10^6 m^3 yr^{-1}	Total Volume change (1980 - 2007) 10^6 m^3 and 10^6 m^3 yr^{-1}
Backbarrier	-3.42, -0.13 (44.2 %)	-4.31, -0.16 (55.8 %)	-7.72, -0.29
Ebb Tidal Delta	-8.27, -0.31 (61.9 %)	-5.08, -0.19 (38.1 %)	-13.35, -0.49
Shoreface	-43.78, -1.62 (14.0 %)	-267.89, -9.92 (86.0 %)	-311.67, -11.54
Spit Platform	N/A*	N/A*	0.24, 0.01
Tidal Inlet	-1.73, -0.06 (135.7 %)	0.45, 0.02 (-35.7 %)	-1.27, -0.05

- Goals and Objectives
  - Quantify the volume and rate of sediment transport through the Barataria Estuary Barrier Islands
    - Separated into sand and fine fractions
    - Compute average annual rates
    - Compute quantities and rates during storm events
  - Estimate long term morphology change
  - Validate / Update Conceptual Sediment Budget
    - Update erosion / deposition by geomorphologic unit
  - Identify primary drivers including winds, tides, and wave components

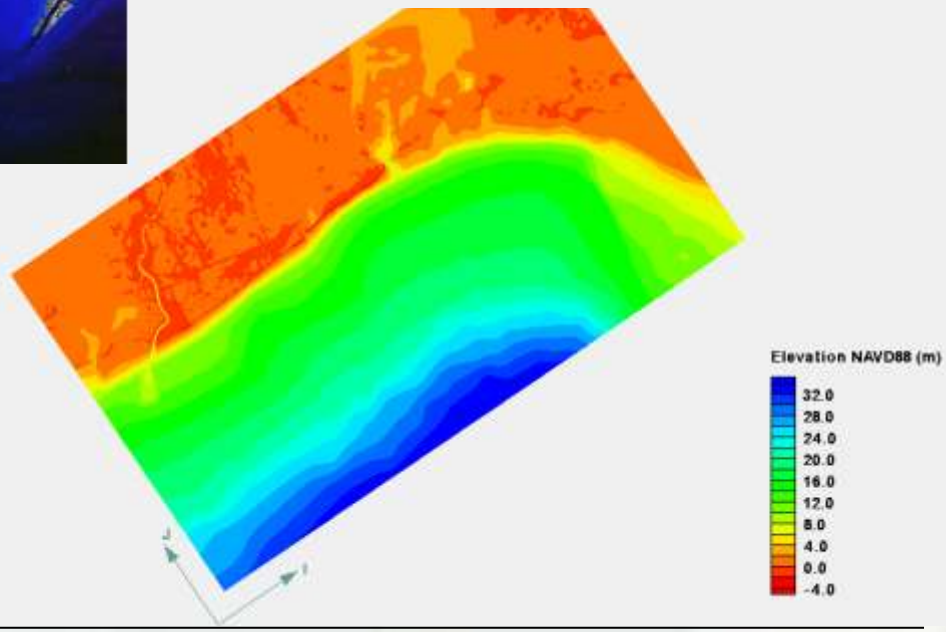
Numerical Modeling with Coastal Modeling System (CMS)

- Methodology
  - ► Model Setup / Geometry
    - Existing Conditions
      - ▷ Topographic and bathymetry elevations derived from current high resolution ADCIRC mesh (HSSDRS/FEMA model)
    - Historic Conditions
      - ▷ USGS 1980s topographic and bathymetric elevations
  - ► Validation
    - Tide Simulations 2008 validated to NOAA/LSU gages
    - Hurricane Gustav 2008 water level observations
    - Hurricane Gustav 2008 wave observations and ADCIRC / STWAVE numerical modeling
  - ► Sediment Transport
    - Extract sand and fines fractions as well as multiple grain sizes from large boring and vibra core data sets

Numerical Modeling with Coastal Modeling System (CMS)

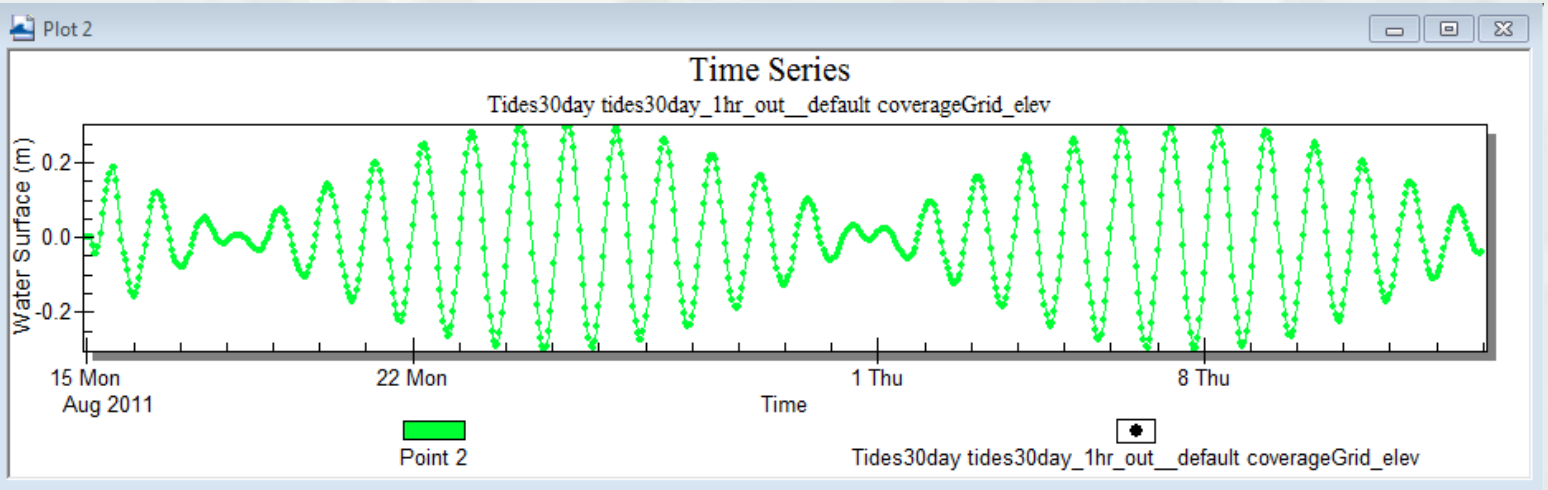
Cartesian Grid Module | Map Module | Mesh Module | Scatter Module | Raster Module

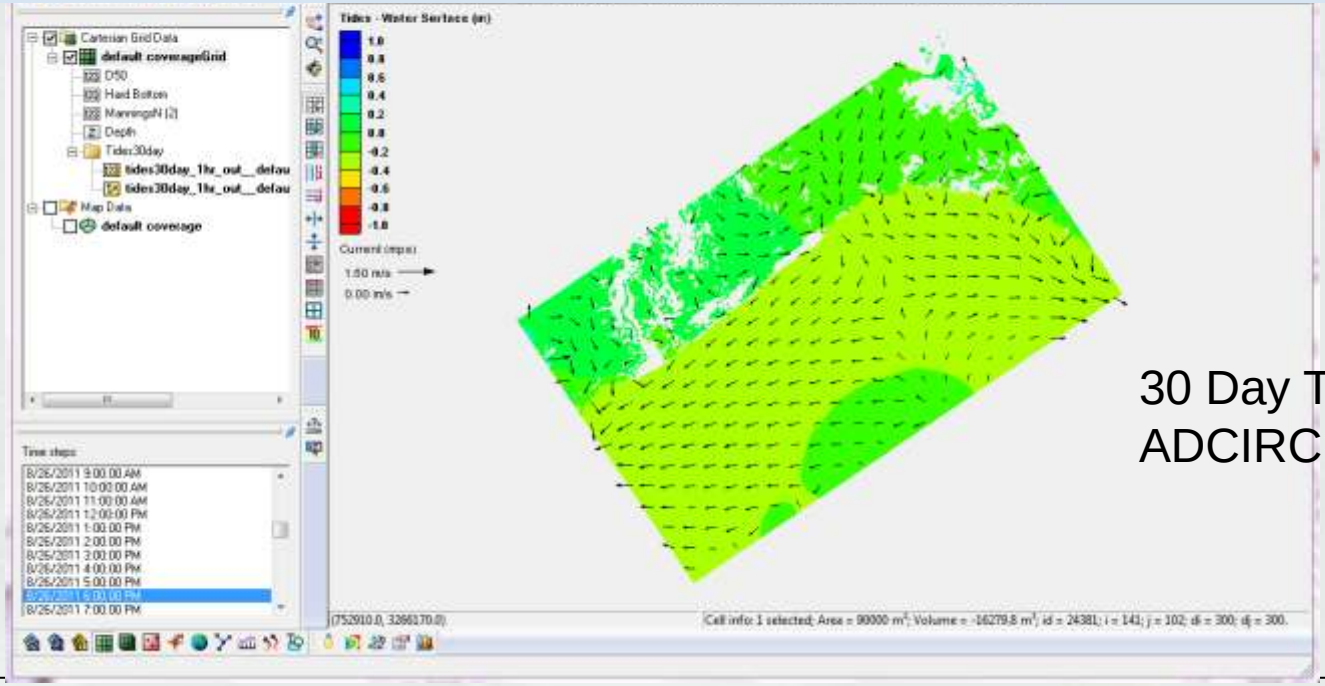
Number of cells:	186998	Number of monitoring stations:	4
Number of rows:	259	Number of ocean cells:	186998
Number of columns:	722	Number of land cells:	0
Number of subgrids:	0		
Minimum Z value:	-4.97	Minimum row height:	28.58
Maximum Z value:	35.43	Maximum row height:	299.43
Angle:	34.06	Minimum column width:	100.00
		Maximum column width:	100.00



CMS Model Domain
Existing Conditions Geometry

CMS Validation Tide Simulations

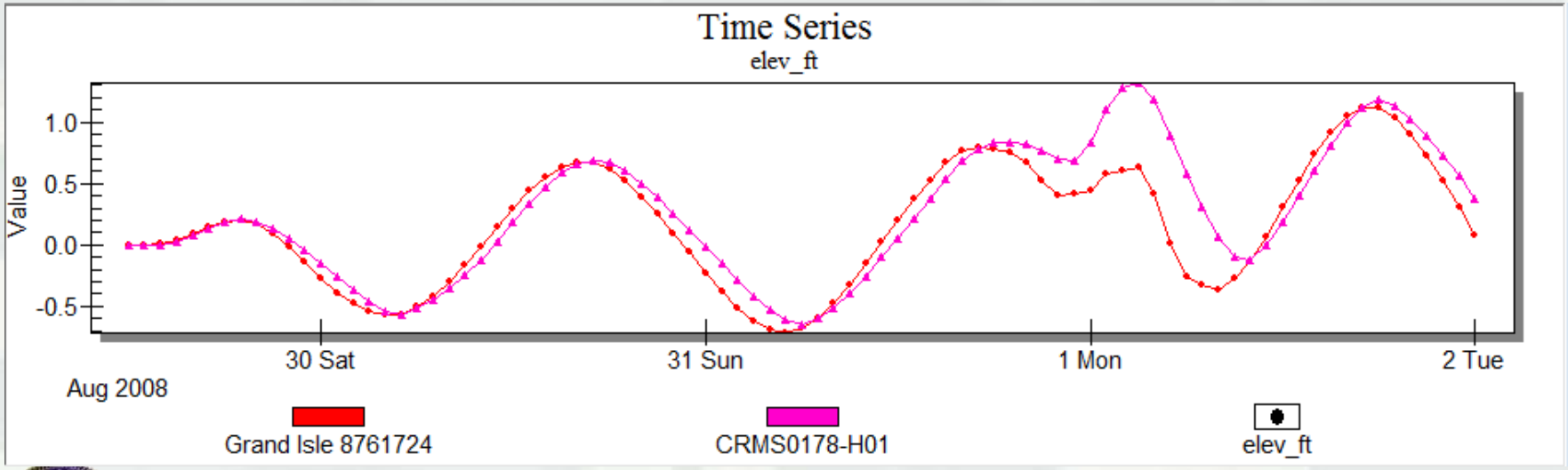




30 Day Tide Simulations
ADCIRC Tides Database

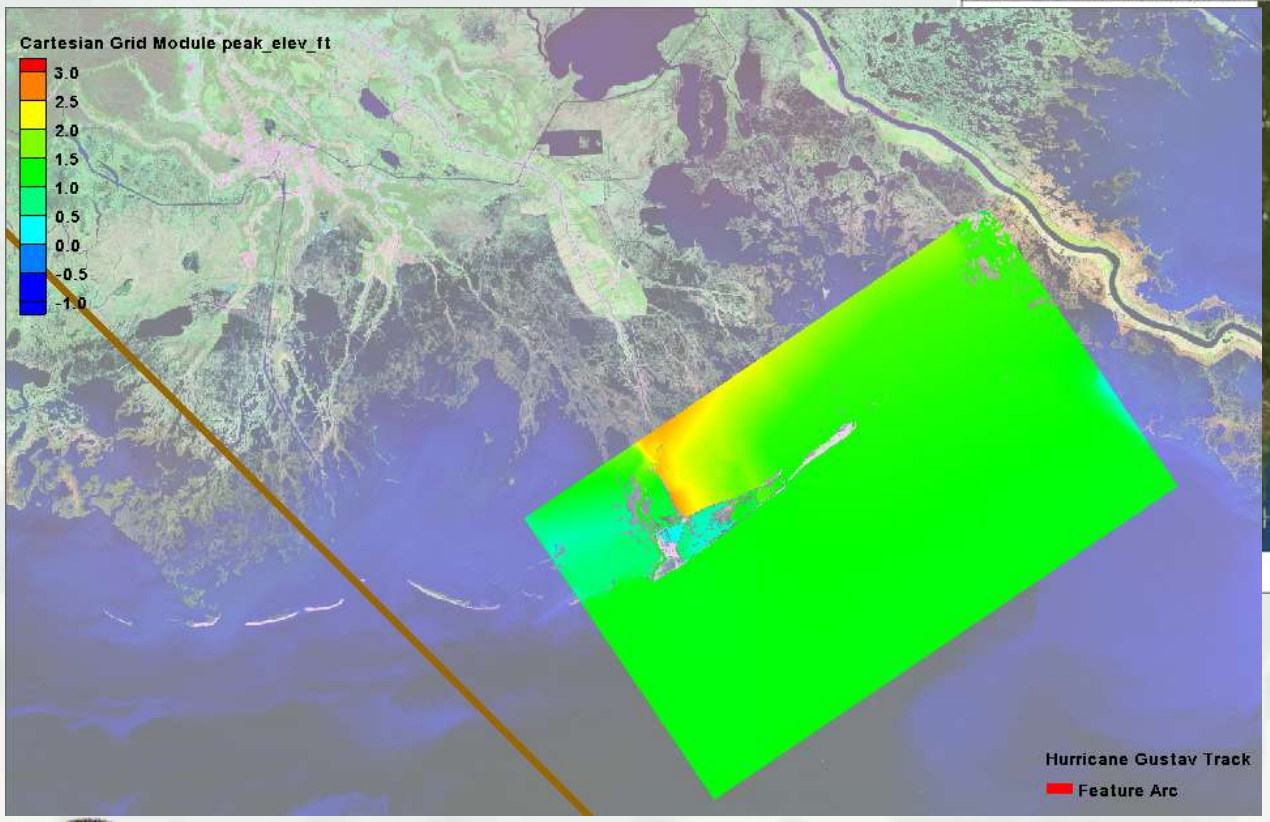
CMS Validation Hurricane Gustav

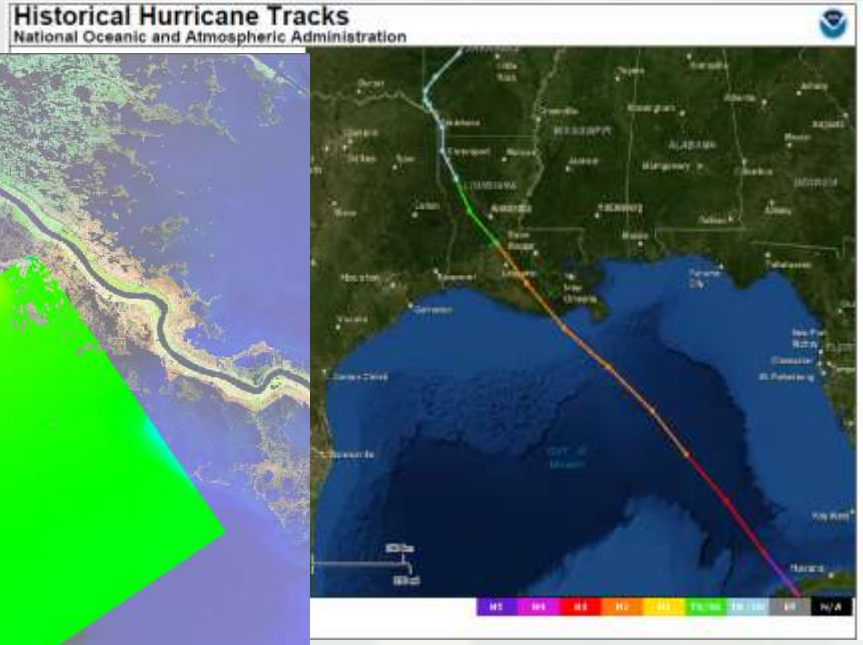
- Time Period – 29 August to 3 September 2008
  - 6 day simulation
- DT = 1.0 sec
- Ocean Weather, Inc – “Best” Wind speed and pressure
- Grand Isle and USGS, CPRA, NOAA Tide Gages



CMS Validation Hurricane Gustav

Gustav Peak Water Elevations (ft)



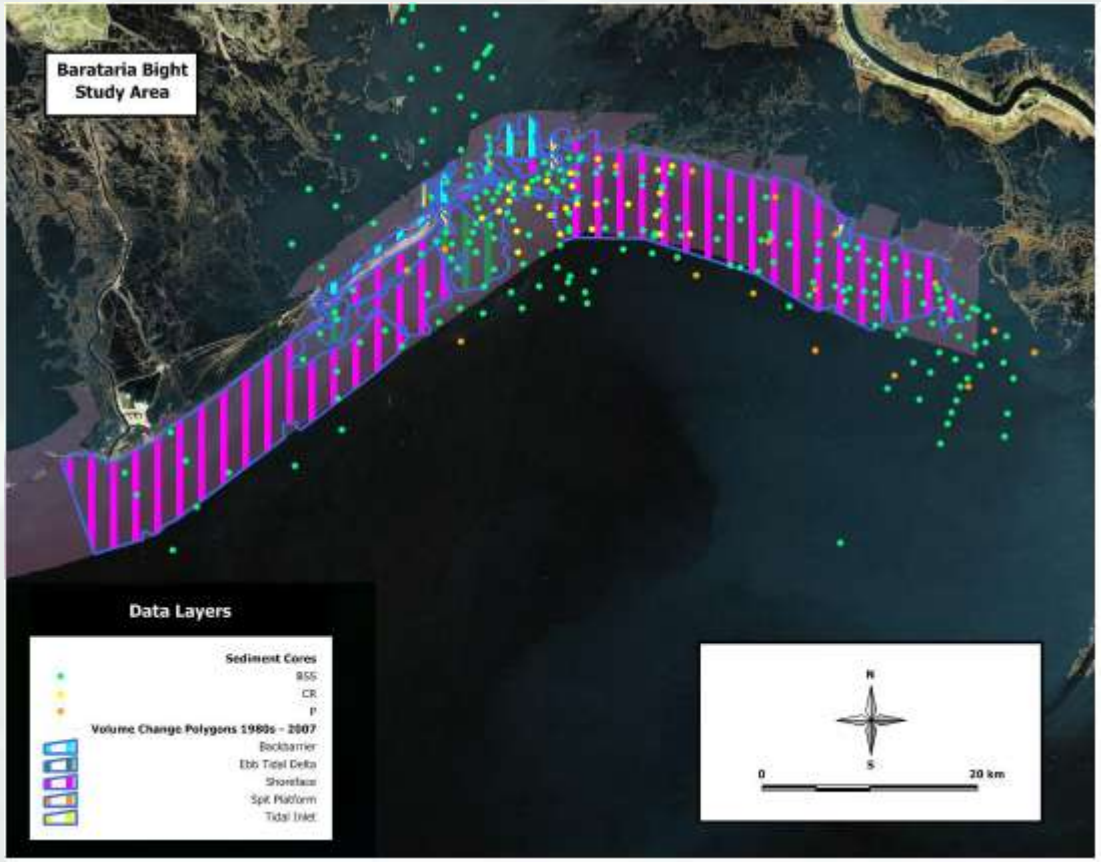


CMS Sediment Transport

- Data Sources
  - USACE New Orleans District, USGS, Louisiana CPRA – LASARDS, University of New Orleans
  - Sand and Fines - Geotechnical Borings and Vibra Cores provide sediment characteristics including grain sizes and depths
- Sediment Transport – Evaluations
  - Both Single and multiple grain sizes
  - Non Equilibrium Total Transport
  - Equilibrium Transport –
    - Lund-CIRP
    - Soulsby-van Rijn Total-load Transport Formula

CMS Sediment Transport

- UNO and State of Louisiana LASARD Data Sources



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Opportunities to take action:

- Continue expansion of coastal change data
- Leverage ongoing coastal projects
    - LCA, River Diversions, MRHDMS
- Use Data sets and Numerical Models for alternative analyses in USACE projects and CPRA Coastal Master Plans
- Integrate CMS model into MRHDMS modeling
- Integrate dredge operations

Volume of Sediment Moved

- Volumes by Geomorphic Unit (average annual)
- Shore-face
    - Conceptual Budget ~ -11.1 x 10^6 cu-yards
    - UNO Historic ~ 15.1 x 10^6 cu-yards
    - CMS Modeling – on going computations
- Tidal Inlets, Back Barrier – next steps

Accomplishments

- Creation of Coast wide Conceptual Budget
- Creation of Coastal Change Database
- Creation of First Numerical Modeling Tool
    - Specific to regional sediment modeling
- Results to provide model based volumes and rates to update Conceptual Budget

Lessons Learned

- Stakeholders and Partners need to be continually engaged in all efforts
- Interagency collection, processing, and sharing of data sets critically important
- Important to continue to build data sets as well as numerical models to address complex ecosystem and coastal challenges